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Mega programs as new trends integrating various research disciplines

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Abstract: The Consultative Group on International Agricultural Research (CGIAR) vision is to reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership. By creating and facilitating innovative technologies, exploiting vast germplasm resources, marshalling public and private research through a broad network of partnerships, and pointing the way to policy and institutional innovations, the international research centers of the CGIAR are well positioned to contribute to the global effort to foster food production, sustainably manage natural resources, increase access to food, and reduce poverty and hunger in both rural and urban areas. The identified MPs are: Crop Germplasm Conservation, Enhancement, and Use—2. Diets, Agriculture, Nutrition, and Health 3. Institutional Innovations, ICTs, and Markets 4. Climate Change and Agriculture 5. Agricultural Systems for the Poor and Vulnerable 6. Water, Soils, and Ecosystems 7. Forests and Biomass. These MPs and the Strategy and Results Framework-driven CGIAR would reach billions of people. A reformed and more efficient CGIAR, working with partners, will not only help increase productivity, improve the natural resource base, and strengthen policy and institutions through its own research, but also be better able to link with private sector innovation and to end users, incl. farming communities. The result will yield high payoffs to development investments.

Keywords: *mega programs, environment, people*

المستخلص: تتلخص رؤية الفريق الاستشاري للبحوث الزراعية الدولية (CGIAR) للحد من الفقر والجوع، وتحسين الصحة والتغذية البشرية، وتعزيز مرونة النظم الإيكولوجية من خلال البحوث الدولية الزراعية ذات الجودة العالية، والشراكة ، والقيادة. ومن خلال خلق وتسهيل التقنيات المبتكرة، واستغلال الموارد الوراثية ، وتنظيم البحوث العامة والخاصة من خلال شبكة واسعة من الشراكات ، وتنظيم السياسات والابتكارات المؤسسية ، وCGIAR ،من خلال، مراكز البحوث الدولية التابعة للمجموعة الاستشارية ليها المقدرة على المساهمة في الجهود العالمية لتعزيز الإنتاج الغذائي، وإدارة الموارد الطبيعية على نحو مستدام، وزيادة فرص الحصول على الغذاء، والحد من الفقر والجوع في كل من المناطق الريفية والحضرية. المشاريع المتداخلة الضخمة (MP) التي تم تحديدها هي : حفظ المادة الوراثية المحصولية وتعزيزها واستخدامها - 2. الوجبات الغذائية، والزراعة والتغذية والصحة 3. الابتكارات المؤسسية، تكنولوجيا المعلومات والاتصالات، والأسواق 4. تغير المناخ

والزراعة 5. النظم الزراعية التي تساعد الفقراء والضعفاء. 6 المياه والتربة والنظم البيئية 7. الغابات والكتلة الحيوية. من خلال الاستراتيجيات وفي إطار النتائج المحفزة تعمل CGIAR لتوصيل هذه المشاريع الضخمة إلي المليارات من الناس. تجري CGIAR بعد الإصلاحات لتكون أكثر كفاءة للعمل مع الشركاء ، ليس فقط للمساعدة في زيادة الإنتاجية، وتحسين قاعدة الموارد الطبيعية ، وتعزيز السياسات والمؤسسات من خلال بحوثهم الخاصة ، ولكن أيضا لكي تكون أكثر قدرة على الارتباط مع المبتكرين في القطاع الخاص من أجل خدمة المجتمعات الريفية. ستكون النتائج المتوقعة من الاستثمارات في التنمية عوائد ربحية عالية.

كلمات مفتاحيه: المشاريع الضخمة، البيئة، الناس

Introduction

Recent food and financial crises have had serious implications for food and nutrition security in developing countries. In 2007 and 2008, the price of nearly every agricultural commodity rose sharply, creating a global food price spike. Several factors contributed to these unprecedented food price increases: climate change, rising energy prices and subsidized biofuel production, income and population growth, globalization, and urbanization. Increased volatility and risks are lasting features of the world food system and require urgent attention. These higher and more volatile prices complicate the task of feeding the world's growing population. Poor people spend 50 to 70 percent of their income on food. Because wages for unskilled labor tend not to rise along with food inflation, the poor have little capacity to adapt as prices go up. Moreover, even before the recent food crisis, the poorest of the poor were being left behind. Shortages of water and land are becoming more frequent, and climate change will further threaten agricultural productivity and production by increasing climate variability, temperature, and the risk of droughts and floods. The consequences of natural resource depletion and degradation are a dire threat to the future of civilization.

The Consultative Group on International Agricultural Research (CGIAR) was established with the vision is to reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership. It has identified seven mega programs (MP), and two platforms, gender platform and capacity strengthening plat form.

Strategic Objectives setup by CIGAR :

1. Create and accelerate sustainable increases in the productivity and production of healthy food by and for the poor. (—FOOD FOR PEOPLE||)

2. Conserve, enhance, and sustainably use natural resources and biodiversity to improve the livelihoods of the poor in response to climate change and other factors.(—ENVIRONMENT FOR PEOPLE||)
3. Promote policy and institutional change that will stimulate agricultural growth and equity to benefit the poor, especially rural women and other disadvantaged groups. (—POLICIES FOR PEOPLE||)

Materials and methods

The details of the seven MPs are shown below; two platforms will work toward system synergy and effectiveness in two key areas, cutting across all MPs and also focusing on tangible results: The gender platform will facilitate strong attention to gender issues and research cooperation on these issues across MPs. The expected results are increased involvement and income of women in agriculture in terms of production, marketing, and processing and reduced disparities in their access to productive resources and control of income. The agenda draws on a wide consultation process conducted a few months ago.
The capacity-strengthening platform will help national agricultural research systems and other research partners—both public and private—through research networks, innovative information and communication and knowledge management methods and resources. A focused program will help strengthen capacities in national agricultural research systems, including university capacity in research and training. The expected results are enhanced participation of national scientists in global research networks, strengthening of national agricultural research systems to be more effective, independent research partners, widespread use of valuable new knowledge management tools and resources, and strengthened universities producing skilled researchers for national agricultural research systems.

Mega programs proposed by CIGAR

MP1- Crop Germplasm Conservation, Enhancement, and Use

Crop yield growth in the main food staples is slowing, and production is slipping below demand. Crop yields need to increase about 50 percent by 2030 to meet the food demands of the growing world population, particularly in the developing world. The CGIAR has achieved huge successes in meeting its goals for sustaining and improving the availability of food and reducing poverty through breeding and genetic enhancement methods. There are exciting new opportunities to integrate the analytical power of molecular science with traditional approaches

to speed the timeframe for research. Plant breeding with the help of molecular technologies can contribute significantly to the achievement of yield increases. The basic science for crop enhancement for the world's leading crops, i.e. rice, maize, wheat, sorghum and millets, and roots and tubers, and pulses, and fruit and vegetables are the focus of this MP. The CGIAR is the world's largest repository of collections of genetic resources for most food crops and these together with their characterization represent a major international public good of the CGIAR. They are held in trust for humanity, under the International Treaty for Plant Genetic Resources for Food and Agriculture. As this MP is likely to be large, subprograms within the MP will make the research programs manageable. One subprogram could concentrate on genetic conservation and characterization, cutting across all crops, and possibly livestock, and fish resources, to take advantage of common platforms of science. System-wide support to information systems and bioinformatics as well as policy and regulatory support would benefit work on all crops. The cross-crop work would be on the following themes:

Genetic resources conservation and assessment and gene discovery: This program will support the collection, conservation, enhancement, use, and distribution of wild relatives, cytogenetic stocks, genetic populations, and molecular genetic resources.

Information systems: This program will integrate bioinformatics and crop information systems.

Institutional and regulatory support: The MP will strengthen capacity to manage intellectual property and promote deployment systems for safe use of new technologies. Partnerships with the private sector will be especially important to allow for access to proprietary tools and technologies that can provide traits of importance to poor farmers and consumers. Policies are also needed to harmonize regulations on variety release, seed regulations, and phyto-sanitary legislation. Work on genetically enhancing crops will focus at the crop level, and interactions of genetic improvement with efficient and sustainable cropping systems will have the individual crop work serving to support the system work of MP 5 on agricultural systems for the poor and vulnerable. The focus can be partly guided by crop-potential mapping (The crop-specific themes are as follows:

Genetically enhanced germplasm (advanced populations, lines, and clones, plus genetic stocks): This subprogram will continue strategic breeding and pre-breeding research in close partnership with national systems, with the aim those national systems will take over most of the applied breeding activities through their own networks and partnerships. The program will sharply increase support to innovative long-term research to push out the yield frontier of major food crops through processes such as transfer of the C4 photosynthetic pathway, changing plant architecture, and heterosis.

***Interaction of genetic improvement with efficient and sustainable cropping systems*:**

This subprogram will maintain clear links to MP 5 for work in specific regions that focuses on agronomy, and to MP 6 (on water, soils, and eco-systems), with a special emphasis on enhancing input efficiency (for example, nitrogen use efficiency and even fixation) and reducing losses from biotic and abiotic stresses. A major challenge will be to integrate adaptation to climate change by reducing vulnerability to evolving stresses, such as drought, heat, and changing pest populations. The work of this MP and MP 5 will also need to be closely linked to the work on institutional innovations, ICTs and markets, especially in terms of input and output market innovations and value chains (MP 3). Especially at the output level, value chains merge commodities upstream in processing and marketing systems downstream, thus making it essential to consider these issues across commodities and not in a commodity specific way only.

MP2- Diets, Agriculture, Nutrition, and Health

Hunger, poor health, and undernutrition are key intertwined features of poverty and a strong focus of the Millennium Development Goals (MDGs). Reducing the number of undernourished people (MDG 1) requires that the poor have access to enough food to meet their daily caloric requirements and to food of the right nutritional quality to prevent deficiencies of essential micronutrients such as iron, zinc, and vitamin A. Good nutrition, particularly in these critical micronutrients, is crucial to fighting infections and reducing the overall burden of disease, as well as to preventing maternal and child mortality (MDGs 4, 5, 6). Agriculture provides longer-term solutions to hunger, malnutrition, and poor health by providing more affordable and more nutritious foods and developing agricultural systems and policies that minimize health risks and maximize health benefits from food. Agricultural investment is therefore critical to the long-term sustainability of food for people and to ensuring a healthy diet for 8 to 9 billion people by the middle of this century.

Research activities and communities in the agricultural and health sectors have long been isolated from one another. This mega program will be a flagship initiative in integrating agricultural and health research for improving the nutrition of the poor. The mega program will have two component programs, linked by a research platform for close collaboration between the agricultural and health research communities at the international and national levels. The recently established Agriculture and Health Research Platform (AHRP), which links CGIAR centers, the World Health Organization, and several other health institutions and experts, will be expanded for this purpose.

Component 1: Improving maternal and child nutrition through improved nutritional value of foods and overall diet quality

Young children and women of reproductive age are highly nutritionally vulnerable and failure to protect nutrition during pregnancy and early childhood has potentially devastating consequences for a country's development. This program focusing on women and young children will undertake research on improving women and children's access to inexpensive, nutritious food. The very poor largely depend on cereals for the bulk of their energy and micronutrient intakes, but animal-source foods, fruits, and vegetables are much richer sources of micronutrients. Research under this program will therefore also focus on improving poor people's access to local, affordable animal-source foods, fruits, and vegetables, through innovation in production, access, and marketing. Improving food policies, for example on pricing or food stocks, will be a strategy for provision of inexpensive, nutrient-rich foods. This program will continue and substantially scale up nutrition-specific biofortification research and dissemination to end-users already being undertaken by centers of the CGIAR under HarvestPlus Challenge Program. It will involve innovative breeding research with agricultural research institutions and testing of promising new varieties in local contexts with national agricultural research systems. It will implement intersectoral research involving agriculture, health, and nutrition institutions and experts. It will also extend food economics and policy research to address policies that will improve supply of inexpensive nutrients to the poor.

Component 2: Changing agricultural systems to improve health outcomes

Agricultural systems have major impacts on health that do not involve the direct provision of food and nutrition. These impacts operate through food chains, the role of water in food production, enhanced disease risks associated with these processes, and the broader relationship between population health and agricultural productivity. In all of these relationships, the poor are demonstrably at greater risk. This mega program will reverse past failures to integrate agricultural and health research and knowledge.

MP3- Institutional Innovations, ICTs, and Markets

Improving the institutional settings in which poor farmers and food consumers operate represents an underutilized opportunity for reducing poverty and improving food security. The mega program outline here aims to unleash an institutional and information revolution with and for farmers and the rural poor that improves and secures their livelihoods, and also promotes innovation along value chains. These changes are designed to strengthen poor people's capacity as economic and social actors. Areas of low market access have even more difficulty

in entering new agricultural value chains and thus are in even greater need of institutional innovations to make their agricultural products competitive.

This mega program aims to expand proven successes and adapt existing institutional innovations locally to accelerate agricultural development; facilitate reforms that reduce harm from ill-designed institutional arrangements; and breed institutional innovations and test and expand them, drawing on the worldwide network of centers and their partners in the public and private sectors.

MP4- Climate Change and Agriculture

This mega program takes an integrated and holistic view of what, where, and how severe climate change will be with respect to environmental and related agricultural impacts. It will develop a research agenda that looks at optimum adaptation strategies for different areas. This mega program will build on the platform provided by the Climate Change Challenge Program and other work being conducted in the CGIAR centers and with partners to develop a comprehensive approach to how agriculture will cope with the impacts of climate change to ensure ongoing food security. It will develop strong links with other mega programs dealing with adaptive management responses and mitigation of climate change. It will for the first time ensure that the CGIAR and key partners have an integrated, systemic approach to how the world will deal with potentially the greatest threat to poverty alleviation and food production. Particular emphasis will be given to three thematic areas:

1. *Developing a knowledge base about climate change and toolkits to assess its impact:* Work will focus on analyses of potential development scenarios under a changing climate and differing pathways of economic development. Research will also identify climate trends and variability and assess methods for downscaling climate change information for agriculture and natural resources management. It will develop an integrated assessment framework and toolkit to enhance scientists' ability to assess climate change impacts on agricultural systems and their supporting natural resources. And it will include analysis of the likely effects of specific adaptation and mitigation options.

2. *Identifying adaptation options for agricultural and food systems:* Work will focus on identifying water and other natural resource management strategies, as well as rural livelihood portfolios that buffer against climate shocks and enhance livelihood resilience. The MP will analyze and evaluate index-based risk-transfer products to protect and enhance rural livelihoods and identify improved approaches for managing climate risk through food storage, trade, and distribution.

3. *Identifying mitigation technologies and policies from the perspectives of different sectors and undertaking cross-MP activities on institutions (such as payments for environmental services):* Work will include the development of tools to examine the synergies and trade-offs between adaptation and mitigation and among multiple goals (such as food security, carbon abatement, and livelihood improvement). The MP will also play a convening role at global and regional levels through stakeholder engagement to develop scenarios with stakeholders, engage in global policy processes, and understand stakeholder needs for new types of information.

MP5- Agricultural Systems for the Poor and Vulnerable

Seventy percent of the world's poor are rural, and most of these 800 million poor people depend on agriculture for their livelihoods. Poor and hungry people are concentrated in particular regions and associated with particular agricultural, fish, and forest production systems, mostly in Sub-Saharan Africa and South Asia. Most of these systems are characterized by major constraints, whether climatic (such as drought), biotic (such as high losses to pests), physical (isolation and poor infrastructure), or institutional (weak institutions and governance). Frequently all four types of constraints act simultaneously, compounding the challenges of development programs targeted on these systems. This goal requires coordinating research across three strategic objectives—that is, increased productivity of crops, livestock, and fisheries, underpinned by improved and sustainable ecosystem services as well as policies and institutions that ensure delivery of the benefits of this productivity to the poor.

This MP will build on the productivity focused science in MP 1 as well as the institutional innovations research in MP 3 and the land, water, and eco-systems research of MP 6. Based on mapping of poor and food-insecure populations along with potential for agricultural improvement, the CGIAR will identify up to five systems or domains, with a minimum of [50] million poor people in each system, where agricultural research focused around common critical constraints in that system offers significant potential to contribute to rapid and sustainable poverty reduction. At least four of the identified systems and domains are likely to be in Sub-Saharan Africa and South Asia.

MP 6- ***Water, Soils, and Ecosystems***

A significant challenge for agriculture this century is to increase agricultural

A significant challenge for agriculture this century is to increase agricultural productivity using a reducing share of water resources; without further soil degradation; and in greater harmony with the environment. This is a mighty challenge given that global food and animal feed

production will likely need to double by 2050. Water shortages are compounded by soil fertility exhaustion, erosion, and salinisation. This mega program, therefore, seeks to deliver outputs that will help increase agricultural production and profitability while sustaining the agricultural environment and associated ecosystems. The focus will be on agricultural and ecosystems characterized by serious over- or underexploitation of water and related natural resources. The mega program aims to harmonize agricultural production and environmental issues in high-priority rainfed and irrigated environments by developing policies, methods, and technologies for improved crop, livestock, aquaculture, and fisheries management. Research is required across scales, from the farm to the agricultural system, river basin, country, and globe. The research will provide science-backed information to farmers, fishers, resource managers, policymakers, investors, and other decision makers on how to adapt to water scarcity and climate change now and in the future; increase land and water productivity for crop, livestock, aquaculture, and mixed farming systems; reduce soil, water, and nutrient footprints where appropriate along the entire production system from field to fork; and promote paid and unpaid ecosystem services and build ecosystem resilience.

MP7- ***Forests and Biomass***

Approximately 30 percent of the world's land area is covered by forests, which contain about 80 percent of Earth's terrestrial biodiversity. Forests serve as a source of income for 240 million poor people, and forest product industries are a significant source of growth and employment in developing countries. Tropical forests support much of the world's biodiversity and provide a range of ecosystem services that are fundamental to the planet's well-being. They help stabilize soils, discourage erosion, maintain a steady supply of clean water, and reduce the main greenhouse gases that fuel global climate change. Deforestation and associated land use changes contribute about 20 percent of greenhouse gases, of which 80 percent come from developing countries. Furthermore, the climate and biodiversity benefits of forests are vital to the welfare of the entire globe and have attributes of international public goods. This mega program with global and national partners will focus on four dimensions of sustainable use and conservation of tropical forests: *Protection of forests, Improvement of incomes,*

1. *Protection of forests:* The mega program will develop policies and governance structures that protect and enhance these resources for poverty reduction while allowing sustainable commercial use of forests. It will place special attention on developing the tools with which governments and civil society can monitor and measure sustainable forest conservation and use.

2. *Improvement of incomes:* Research will also improve income to the poor from trees, forests and biomass, through the use of trees and forest products in emerging value chains. It will give particular attention to institutional innovations that facilitate smallholder and community enterprises and community forestry as well as adaptation to climate change.

3. *Valuation and delivery of ecosystem services of forests:* Research will provide tools for valuing and efficiently and equitably delivering ecosystem services, including biodiversity, landscapes, watersheds, and soil and water conservation. It will place special emphasis on managing trade-offs between sustainable use of forests and their conservation.

4. *Mitigation of climate change:* With the likelihood that the central role of forests will be formalized through the program on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD), research will give special attention to governance, policies, and institutions for efficient and equitable participation of developing countries, and poor people in particular, in the REDD. The research will lead to demonstrable improvements in sustainable, forest.

Results and discussion

By forging new partnerships in programs in which agriculture has a profound impact on human health and nutrition, MP4 is expected to significantly improve the livelihoods of the poor, especially women, as measured by increased incomes and food security, and by enhanced diet quality, health, and nutrition. This partnership agenda will have a strong focus on building capacity of key actors along the impact pathways. On the macro scale, MP4 has the potential to increase the health and nutrition benefits of agricultural research, programs**,** investments, and policies. These benefits can feed back to agriculture, creating stronger, more effective, and sustainable agri-food systems that promote better health and better-nourished producers and consumers. New trans-disciplinary approaches will tackle age-old malnutrition and neglected-disease problems in marginal and vulnerable communities to more effectively improve livelihoods and reduce poverty.

Results expected from MP 5 are impacts on tens of millions of the poorest people, measurable increases in agricultural productivity and production, farmer adoption of proposed agricultural system improvements, increased household production and consumption, measurable increases in income and health, and demonstrable improvement in water use, soil fertility, pest management, and supportive policies. A significant challenge for agriculture this century is to increase agricultural productivity using a reducing share of water resources; without further soil

degradation; and in greater harmony with the environment. This is a mighty challenge given that global food and animal feed production will likely need to double by 2050.

Synergies between MPs are essential for successful functioning. For instance, the MP on crop germplasm enhancement and production needs to closely coordinate with the MP on agricultural systems for the poor and vulnerable because innovation for crop productivity and resilience is critical for achieving rapid and sustainable reduction of poverty and hunger in agricultural systems. The crop germplasm enhancement and production MP also requires close cooperation with the MP on diets, agriculture, nutrition, and health because genetic improvement of crops is necessary to improve the nutritional value of foods and the overall diet quality of poor people. The MP on climate change and agriculture requires close synergies with the MP on institutional innovations, ICTs, and markets because, for instance, weather-related information is essential for identifying successful adaptation strategies. In addition, for climate change mitigation, access to financial services and insurance is crucial. Cooperation between the MP on forests and biomass and the MP on water, soils, and ecosystems is needed to enhance the sustainability of ecosystems. With these strong synergies, the value added of the MP portfolio surpasses the sum of the value of individual MPs operations.

Conclusion

The seven MPs are indeed ―mega‖—large—and while they are clearly distinct, they form clusters of results-oriented innovation activities whose impact is greater than the sum of their parts because of synergies and system-wide cooperation. Four of the MPs address the delivery of international public goods of importance to all agricultural systems (MPs 1–4). The other three MPs, which also provide global public goods, have more of a systems focus, addressing resources (agro-ecosystems, water systems, and forests) that need urgent attention in high-priority regions (MPs 5–7).The proposed MPs will not be of equal size; rather, their proposed size relates to what it takes to get the job done. These MPs and the Strategy and Results Framework-driven CGIAR would reach billions of people. A reformed and more efficient CGIAR, working with partners, will not only help increase productivity, improve the natural resource base, and strengthen policy and institutions through its own research, but also be better able to link with private sector innovation and to end users, farming communities. The result will yield high payoffs to development investments. Better food safety, water quality, and control of occupational, zoonotic, and emerging diseases can reduce disease risks and improve health and nutrition.

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